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(54) Title: **NOVEL COMPOUNDS**

(57) Abstract: CASB88 polypeptides and polynucleotides and methods for producing such polypeptides by recombinant techniques are disclosed. Also disclosed are methods for utilising CASB88 polypeptides and polynucleotides in diagnostics and vaccines for prophylactic and therapeutic treatment of cancers, Crohn's disease, Colitis ulcerosa, colorectal cancer, lung cancer and preneoplastic lesions, breast, brain, uterus, muscle, eye and germ cell cancers, Wilm's tumour, retinoblastoma, rhabdomyosarcoma, leiomyosarcoma and synovial sarcoma, autoimmune diseases, and related conditions.

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ABSTRACT:

CASB88 polypeptides and polynucleotides and methods for producing such polypeptides by recombinant techniques are disclosed. Also disclosed are methods for utilising CASB88 polypeptides and polynucleotides in diagnostics and vaccines for prophylactic and therapeutic treatment of cancers, Crohn's disease, Colitis ulcerosa, colorectal cancer, lung cancer and preneoplastic lesions, breast, brain, uterus, muscle, eye and germ cell cancers, Wilm's tumour, retinoblastoma, rhabdomyosarcoma, leiomyosarcoma and synovial sarcoma, autoimmune diseases, and related conditions.

L'invention concerne des polypeptides et des polynucléotides CASB88, ainsi que des procédés de production de tels polypeptides à l'aide de techniques de recombinaison. Elle concerne aussi des méthodes d'utilisation des polypeptides et des polynucléotides CASB88 dans des diagnostics et des vaccins aux fins de prophylaxie et de traitement

thérapeutique de cancers, de maladie de Crohn, de colite ulcéreuse, de cancer colorectal, de cancer du poumon et de lésion prénéoplastiques, des cancers du sein, du cerveau, de l'utérus, du muscle, de l'oeil et de cellules germinales, de tumeur de Wilm, de rétinoblastome, de rhabdomyosarcome, de liomyosarcome et de sarcome synovial, de maladies auto-immunes et de troubles associés.

TITLE Melt Processible Fluoropolymer Composition **FIELD OF THE INVENTION** The present invention relates to melt processible fluoropolymer compositions made by blending at least two different melt processible tetrafluoroethylene copolymers.

BACKGROUND OF THE INVENTION Tetrafluoroethylene-hexafluoropropylene copolymers (also known as TFE/HFP) have the physical, chemical, mechanical, thermal and electrical properties characteristic of fluoropolymers and can be easily extruded or injection molded. HFP content of commercial copolymers is within the range 9.6 to 17.6 wt% (Ullmann's Encyclopedia of Industrial Chemistry, 5th ed., vol. A I 1, p. 403, 2 2, VCH Verlagsgesellschaft mbH, D-6940 Weinheim, Germany, 1988. The HFP index referred to in this article can be converted to wt% HFP by multiplying 1.5 by 3.2, as disclosed in U.S. Patent 5,700,889). Such properties have led to a growth in the demand for TFE/HFP copolymers, particularly in wire coating applications (e.g., plenum cable). To further increase productivity, there is a need for tetrafluoroethylene-hexafluoropropylene copolymers that can be extruded at higher speeds without loss of extrudate continuity or reduction in the mechanical properties of the extruded article, for example fluoropolymer-coated wire.

Existing TFE/HFP copolymers are unable to fully meet to such requirements.

Although the melt flow of TFE/HFP can be increased by lowering its molecular weight, this is accompanied by a decline in the mechanical properties of the shaped article and a reduction in melt strength, i.e. a tendency for the molten polymer to tear or separate frequently while being stretched and coated, for example onto a metal conductor. This tearing limits the speed of the coating operation. Thus, lowering the molecular weight does not constitute a basic solution.

A number of cases are known in which fluoropolymers have been 30 blended to improve the physical properties of the melt processible fluoropolymer.

For example, blends of TFE/HFP and tetrafluoroethylene-perfluoro(alkyl vinyl ether) (PFA) are described in U.S. Patent 5,041,500, and in the Journal of Polymer Science: Polymer Physics 37, p. 679 (1999). The patent discloses mixtures of TFE/HFP copolymers with tetrafluoroethylene-perfluoro(propyl vinyl ether) (TFE/PPVE), but states that the two components do not co-crystallize. The above-referenced article describes a miscible blend of a TFE/HFP with tetrafluoroethylene-perfluoro(methyl vinyl ether) (TFE/PMVE). However, the TFE/HFP has a low comonomer content and is therefore very similar to 1 polytetrafluoroethylene (PTFE), making it unattractive as a melt-processible material.

European Patent No. 1 000 976 A1 discloses blends of crystalline fluoropolymer with amorphous fluoropolymer or with fluoropolymer containing amorphous segments and crystalline segments for the purpose of reducing the size of the spherulites in the polymer. These segmented copolymers are also known as block polymers because the distribution of monomers throughout the polymer varies according to the block or segment of the polymer that is being considered.

In contrast, typical commercial fluoropolymers are "random" or "statistical" 10 copolymers, the distribution of the monomers along the polymer chain being determined by the monomer reactivity ratios and the concentrations of monomers during the polymerization. Other things being equal, amorphous fluoropolymers are more costly and difficult to make than crystalline fluoropolymers because the former contain less of the lower cost and more reactive fluoromonomer, 5 tetrafluoroethylene. Block copolymers are also more difficult to make because they are conventionally prepared in multistep processes.

New blends of fluoropolymers are needed that will permit faster extrusion rates with no sacrifice of melt strength or mechanical properties, and preferably with improved melt strength and mechanical properties.

SUMMARY OF THE INVENTION In accordance with the present invention, improvements in TFE/HFP

copolymers are obtained by blending therein a PFA based on perfluoro(methyl vinyl ether) (PMVE) or perfluoro(ethyl vinyl ether) (PEVE). In particular it has been discovered that the use of a TFE/HFP dipolymer of a specific composition, or a TFE/HFP terpolymer of a specific composition arrived at by copolymerizing a small amount of PPVE or PEVE or PMVE with the TFE and HFP, yields a blend with the PFA copolymer having good miscibility. The resulting blend has a flex life and melt strength that are greatly improved over those of TFE/HFP alone.

The blend also has improved high-speed processibility in wire coating applications.

Thus the present invention is a melt processible fluoropolymer composition that is a miscible blend of at least two different melt processible fluoropolymers, which composition partakes of the excellent properties of each of the starting materials, and also has improved high-speed wire coating processibility and flex life. By miscible is meant that the composition is homogeneous in the melt phase and that the components co-crystallize on cooling to the solid phase.

2 Accordingly, the invention provides a melt processible fluoropolymer composition having a single crystallization temperature and a single melting point, as measured with a differential scanning calorimeter, said composition comprising.

(A) about 3 to about 97 parts by weight of a tetrafluoroethylene-hexafluoropropylene copolymer comprising about 3 to about 9% by weight (Wt/o) hexafluoropropylene, and 0 to about 4 wt% of a third monomer that is at least one additional monomer selected from the group consisting of perfluoro(propyl vinyl ether) (PPVE), perfluoro(ethyl vinyl ether) (PEVE), and perfluoro(methyl vinyl ether) (PMVE), and about 89 to about 97 wt% tetrafluoroethylene; and (B) about 97 to about 3 parts by weight of a copolymer comprised of about 80 to about 99 wt% tetrafluoroethylene with about 1 to about 20 wt% of one or more comonomers selected from the group consisting of perfluoro(ethyl vinyl ether) and perfluoro(methyl vinyl ether).

1 5 BRIEF DESCRIPTION OF THE DRAWINGS FIG. 1 presents differential scanning calorimetry charts obtained for an TFE/HFP-3 (C)/PFA-C2 (E) mixture. FIG. 1 (a) shows the crystallization peak, and FIG. 1 (b) shows the melting peak.

FIG. 2 presents differential scanning calorimetry charts obtained for an TFE/HFP-3 (Q)/PFA-C2 (F) mixture. FIG. 2(a) shows the crystallization peak, and FIG. 2(b) shows the melting peak.

DETAILED DESCRIPTION The fluoropolymers of this invention can be made according to the methods disclosed in U.S. Patent 5,760,151 for the PFA polymers. For TFE/HFP copolymer, references may be found in U.S. Patents 2,946,763; 3,132,124; and 4,380,618. In the polymers of this invention the monomers are distributed statistically as determined by their reactivity ratios and concentrations during polymerization. They are random polymers, not block polymers.

The TFE/HFP serving as component A in the inventive composition has an HFP content of about 3 to about 9 wtO/o, preferably about 3 to about 8 wt%, and more preferably at least about 3 to less than 7 wt%; about 0 to about 4 wt%, preferably about 0.1 to about 3 wt%, of a third monomer that is at least one additional monomer selected from the group consisting of PPVE, PEVE, and PMVE; and a TFE content of about 89 to about 97 wt%, preferably about 90 to about 96 wt%. An HFP content higher than that indicated above reduces the TFE content below the above range, lowering the crystallinity and crystallization temperature of copolymer A, and thereby increasing the difference between the crystallization temperature of copolymer A and the crystallization temperature of 3 Fluoropolymer Comonomer content (wt%) MFR (g/10 min) TFE/HFP-2 (A) HFP 12% 24 TFE/HFP-3 (B) HFP 11.5%; PEVE 1.2% 22 TFE/HFP-3 (C) HFP 6.5%; PEVE 1.8% 23 PFA-C2 (D) PEVE 13.3% 10 PFA-C2 (E) PEVE 7.1% 19 PFA-C2 (F) PEVE 5.7% 23 MFR: melt flow rate measured at 372°C and under a load of 5kg according to the method of ASTM D 1238.

(2) Measurement of Physical Properties (a) Miscibility.

A differential scanning calorimeter (DSC) is used to determine whether the melt processible fluoropolymer composition co-crystallizes and constitutes a miscible blend in the crystalline region. Using an internal twin-rotor mixer (R-60, 5 The gas permeability measuring apparatus made by Shibata Chemical Machinery Co. is used to carry

out measurements at 230°C on an approximately 0.3 mm thick films prepared by compression molding at 350°C. Nitrogen permeability is commonly used for evaluating membranes for gas permeability. As shown in Table 2, TFE/HFP-3 (C) having a HFP content of 6.5 wt% and a PEVE content of 1.8 wt% co-crystallized with each of the PFA-C2 components. However, TFE/HFP-2 (A) and TFE/HFP-3 (B), which have higher comonomer contents than TFE/HFP-3 (C), do not co-crystallize with PFA-C2.

That is, TFE/HFP-2 (A) and TFE/HFP-3 (B), when blended with PFA-C2, form mixtures that exhibit two melting points and two crystallization temperatures.

Examples 4 to 7, Comparative Examples 7 and 8 Melt blends are made. Flex life measurements are obtained using 10 specimens that are compression molded from the resulting compositions. The results are shown in Table 3. The mixture of PFA-C2 (E) with TFE/HFP-3 (C) markedly improves the flex life.

The melt strength of the above sample compositions at 370°C is measured with a Capilograph. The results are summarized in Table 3. Because the object here is to improve the high-speed spinning properties of TFE/HFP, melt strength measurements are carried out only for mixtures having an TFE/HFP content of at least 60%. Blending PFA-C2 (E) with TFE/HFP-3 (C) results in blends of improved melt strength.

Measured DSC results and DSC charts for the compositions prepared in these examples are summarized in Table 3 and in FIGS. 1 (a) and 1 (b). As is apparent from FIG. 1, TFE/HFP-3 (C)/PFA-C2 (E) blends at all proportions exhibit single crystallization temperatures and single melting peaks, indicating that the blends co-crystallize in all proportions. In particular, the appearance of a single melting point proportional to the composition indicates that the blend is miscible and co-crystallizes.

Table 3 Comp. Ex. 4 Ex. 5 Ex. 6 Ex. 7 Comp.

Ex. 7 Ex. 8 TFE/HFP-3 (C) 100 80 60 40 20 0 PFA-C2 (E) 0 20 40 60 80 100 Crystallization 253.5 254.7 261.6 261.6 264 262.8 temperature (°C) Melting point 278.9 281.2 284.8 288.3 289.7 294.7 (°C) Flex life (cycles) 6,100 14,000 22,000 --Melt strength (g) 0.56 0.59 0.61 0.61 0.61 0.61 8 Examples 8 to 11, Comparative Examples 7 and 9 Melt blends are made using TFE/HFP-3 (C)/PFA-C2 (F). The flex life and melt strength for each of the resulting compositions are measured as in Example 3. The results are summarized in Table 4 and FIGS. 2(a) and 2(b).

The blends of PFA-C2 (F) into TFE/HFP-3 (C) have increased flex life and melt strength.

As is apparent from FIG. 2, TFE/HFP-3 (C)/PFA-C2 (F) blends at all proportions exhibit single crystallization temperatures and single melting peaks, indicating that they co-crystallize in all proportions. In particular, the fact that there appears a single melting point at a temperature that is proportional to the composition indicates that the mixture is miscible and co-crystallizes. Although a single crystallization temperature appears, the crystallization temperature for several of the blends is higher than the crystallization temperatures for either component of the blend. The most likely reason is that each blend component acts as nucleating agent at the time of crystallization. This behavior is reported also in mixtures of different polyethylenes that co-crystallize (Journal of Applied Polymer Science 44, p. 719 (1992)).

Table 4 Comp' Ex. 8 Ex. 9 Ex. 10 Ex. 11 Comp.

Ex. 7 Ex. 9 TFE/HFP-3 (C) 100 80 60 40 20 0 PFA-C2 (F) 0 20 40 60 80 100 Crystallization 253.5 257 259.3 259.3 261.6 258.1 temperature (°C) Melting point 278.5 278.9 279.5 282.1 287.2 288.9 (°C) Flex life (cycles) 6,100 35,000 45,000 Melt strength (g) 0.56 0.66 0.71 Example 12 PFA-C2 (E) has a nitrogen permeability of 0.96 cc(STP)-cm/cm²-sec-cm (Hg). A melt blend of 60 wt% PFA-C2 (E) with 40 wt% TFE/HFP-3 (C) is made and the nitrogen permeability is measured. Nitrogen permeability is found to be reduced below that of unblended PFA-C2 (E) 9

1. A melt processible fluoropolymer composition having a single crystallization temperature and a single melting point, as measured with a differential scanning calorimeter, said composition comprising: (A) about 3 to about 97 parts by weight of a tetrafluoroethylene-hexafluoropropylene copolymer comprising about 3 to about 9 wt% hexafluoropropylene, and 0 to about 4 wt% of a third monomer that is at least one additional monomer selected from

the group consisting of perfluoro(propyl vinyl ether), perfluoro(ethyl vinyl ether), and perfluoro(methyl vinyl ether), and about 10.89 to about 97 wt% tetrafluoroethylene; and (B) about 97 to about 3 parts by weight of a copolymer comprised of about 80 to about 99 wt% tetrafluoroethylene with about 1 to about 20 wt% of one or more comonomers selected from the group consisting of perfluoro(ethyl vinyl ether) and perfluoro(methyl vinyl ether).

2 The melt processible fluoropolymer composition of claim 1, wherein the third monomer of copolymer A and the comonomer of copolymer B are perfluoro(methyl vinyl ether) or perfluoro(ethyl vinyl ether) or both.

3 The melt processible fluoropolymer composition of claim 1 wherein the tetrafluoroethylene content of copolymer A is equal to or greater than the tetrafluoroethylene content of copolymer B, and the difference between the tetrafluoroethylene content of copolymer A and the tetrafluoroethylene content of copolymer B is in a range of 0 to about 6 wt%.

4 The melt processible fluoropolymer composition of claim 1 wherein the tetrafluoroethylene-hexafluoropropylene copolymer comprises at least about 50 parts by weight or more of said composition. 10

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